SUPPLEMENT.

The Mining Journal,

AILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Original Correspondence.

THE TEES SIDE IRON WORKS.

Tees Side Iron Works, carried on by the firm of Messrs. Hopkins, , and Co. (Limited), are situated on the banks of the River n the immediate neighbourhood of Middlesborough. They ise four blast-furnaces, forges, and rolling-mills, which, with undry, fitting-shop, roll-turning, smiths, and other shops in ction with them, give employment to about 1400 men and boys. ngineering works, where engines and bridge work of all kinds anufactured, are situated nearly in the centre of the town, and mployment to about 1000 persons. The mechanical appliances t into requisition at these iron works form their most remark- eatures, and will be afterwards described in detail; the works sceptible of further improvements, which are gradually being d out; this will make them, in their improved and more finished the most important iron works in this locality, both as to extent duction and the economy with which the various processes of facture are conducted.

AST-FURNACES.—The ironstone is imported principally from the land mines, the coke from South Durham, and the mountain one from Weardale. Four blast-furnaces are erected, and in tion. Two of these, erected in 1857, are 55 ft. in height, 16 ft. ter at the bosh; they produce about 300 tons of pig-iron each eek. The furnaces are closed at the top in the usual form in istrict with the cup and cone, the gas being utilised for heating oves and boilers. At the two older furnaces three stoves are o each furnace, the cast-iron pipes in which are double, and n diameter; there are three tuyeres to each furnace, the pres- f blast is 3 lbs., the temperature at the tuyeres 1000°. The g-engine for these two furnaces is a beam non-condensing one; am rests on cast-iron standards. The steam cylinder is 40 in., owing cylinder 96 in. in diameter, 8-ft. stroke, 45 lbs. steam re, going 15 strokes, and supplying 12,060 cubic feet of air per e. The connecting rod to the fly-wheel is attached between the and steam cylinder end of the beam. From the end of the eel shaft a pump is worked, which forces water to the tank on p of the house. Six plain cylindrical boilers, 75 ft. by 4½ ft. in ter, supply this engine with steam; each is suspended from five l girders, and covered with brickwork. Two large calcining (on the patent of Mr. Gjers, the engineer for this and the ad- g Linthorpe Works) are erected for the Cleveland ore; they ft. in height, each has a capacity of 8000 cubic feet, and will one blast-furnace with calcined stone. One ton of small coal eze will calcine 30 tons of raw stone. The shell of the kilns ught-iron plates is lined with 15-in. fire-brick work. The lower f the shell and lining slopes inwards to the opening, where lcined stone falls through; this opening is divided by eight on pillars, 2 ft. in height, and capped by an annular plate, on the structure rests. A cast-iron cone in the bottom of the rows the stone out at the openings. The ironstone is con- to the top of the kilns by means of a 30-feet pneumatic lift is afterwards described), and the limestone is conveyed to ntry over an inclined locomotive road. The furnace lift, 55 ft. ght, is put in motion by a pair of 10-inch inverted cylinders, acting to a drum 3½ feet in diameter, fixed below the range of tform. A single platform is worked by four wire-ropes on the two winding and two unwinding alternately. The rising of tform is assisted by four balance-weights, working in four ht-iron tubes; these tubes, the whole height of the lift, serve guides at the four corners of the platform. Two of the ropes e platform with empty wagons down, raising at the same time lance-weights; the other two ropes, passing over two sheaves top, raise again the platform and laden wagons, the balance- s assisting in the operation. It should be observed that a on wagon of coke is raised by this lift, and tipped at once into rnace, through its hopper bottom. The ironstone and limestone so delivered from iron hopper-wagons into the furnaces, in si- large quantities.

new blast-furnaces, erected in 1866, are situated some distance hose last described, as a separate plant; their height is 75 ft., at the bosh, hearth 8 ft. in diameter and 8 ft. in height. The f each furnace rests on four brick pillars; the external diameter ft. at the bottom, above the pillars, and 28½ ft. at the top, all with fire-brick, and hooped with iron bars. The capacity of furnace is 20,000 cubic feet; the produce of pig-iron is about ns per week from each. Five stoves are built to each furnace, double cast-iron pipes, of the flat form in section. There are tuyeres to each furnace. The pressure of blast is 4 lbs.; the rature of the tuyeres is 1150°. The lift adopted at these two ces is on the pneumatic principle, patented by Mr. Gjers. As neumatic lift is found to work safely and steadily, and as eco- ally as the steam-lift or water-balance, it is being introduced er works besides those just named. One table or platform is 15 ft. square; the motive-power is exerted in a central tube of ron, bored, 36 inches in diameter, the whole height of the lift .) having a piston of 5 tons weight working within it. The orm is connected to the piston by four wire-ropes, which pass four sheaves fixed at the top of the tube. The top of the tube open, the air is alternately exhausted and compressed in it under iston. The weight of the platform and empty barrows being 4½ tons, a compression of 2 lbs. per inch is sufficient to effect ising of the piston and the depression of the platform. When reatest lode is being raised, with ironstone on the platform, an ustion of 4 lbs. per inch under the piston is required, the weight e piston assisting this operation; the power can thus be accom- ted to the weight being raised to any degree. The engine for lift has two 11-inch cylinders, placed diagonally, 16 in. stroke; ir-cylinders, single-acting, 30-inch in diameter, 20 in. stroke; ngine and pneumatic apparatus are equal to the supply of two e largest furnaces; it is not desirable for this or other princi- lift to supply more than two furnaces, otherwise with more a distance to wheel the material is incurred. Behind the stoves e hopper, containing 200 tons of coke, four calcining kilns, and y for coke and limestone are placed, all in line, 30 ft. in height the surface. The materials are raised to the gantry and top kilns by a 36-ft. lift, also on the pneumatic principle. In this here are two air-tubes of 48 inches in diameter, 14½ ft. apart, the platform working between them; the piston in each tube is connected by two wire-ropes to the platform; the weight to be raised by this is much greater than in the furnace-lift; 10 tons of ironstone is carried in each truck, making, with the weight of the truck, 15½ tons to be lifted, requiring an exhaustion of 6 or 7 lbs. per inch under the pistons. The engine in connection with this pneumatic lift is similar to that described for the furnace-lift. At the opposite end of the gantry the empty wagons are dropped down 30 ft., also by pneumatic apparatus; the air-tubes in this case are two, of 36 in. diameter. The four calcining kilns are 30 ft. in height, 20 ft. in diameter internally at the top, and of similar construction to those at the old furnaces. The capacity of each kiln is 5500 cubic feet.

There are three independent blowing-engines, erected in one building, by Stevenson and Co., Preston, in 1866; these are appropriated to the new furnaces. Each steam cylinder, placed at top, is 32 in.; the blowing-cylinder, placed beneath, is 72 in. diameter, 4-ft. stroke, non-condensing. The cylinders rest on two hollow cast-iron side frames; a connecting-rod gives motion to the fly-wheel shaft, placed at the floor level, and two fly-wheels of 6 tons each. The suction valves communicate with the exterior of the building, through a pipe 5 ft. in diameter; the delivery pipe is of the same size. These engines ordinarily go 25 strokes per minute, and can be driven to 40 or 45 strokes with safety. At the rate of 25 strokes three engines will supply 16,950 cubic feet of air. The first engines of this type were erected six years ago, at Linthorpe, by Mr. Gjers, and they are now adopted at many other works. Three other distinct engines in the same building pump water to the tank and boilers; each engine has two small vertical cylinders, and works two 6-inch rams. Five plain boilers, 60 feet by 4½ feet, four of which are always at work, supply the blowing and pumping-engines; each boiler is suspended from five cast-iron girders. The pressure of steam is 55 lbs. The boilers and steam-pipes are covered by Jones's patent non-conducting composition.

FORGES AND ROLLING-MILLS.—There are altogether 112 puddling-furnaces, two forges, three rolling-mills, and one blooming-mill, placed in two different establishments in proximity to the blast-furnaces. These works have not been laid out, as a whole, on any preconceived plan; extensions have been made as the iron trade of the district was developed and expanded. A notable feature in their arrangement is that each mill is driven by an independent engine, the power in most cases acting direct to the rolls, thus saving the outlay for heavy gearing, and its consequent friction and liability to breakage. The other appliances usually required in forges and mills are, as a rule, put in motion by independent small engines. These appliances comprise four cropping-shears in the forges, two circular saws, straightening presses, two punches, and shears in the mills. One pair of shears is used for cropping old rails of 70 or 80 lbs. weight per yard, making seven or eight cuts per minute. Altogether 31 small engines are used to drive these adjuncts, and in pumping water and other operations. To supply the whole of the engines and steam-hammers with steam 38 boilers, heated by waste heat, principally from the mill furnaces, are used, and 10 other boilers fired with coal. The number of the latter will be reduced by applying the waste heat of the furnaces to more boilers, and thus in time the whole of the steam may be generated in this way. At the old works there are No. 1 forge and two mills in operation. No. 1 forge engine has one 26-in. horizontal cylinder, 5 ft. stroke, acting direct to a train of four pairs of rolls on one side of it, making 55 revolutions per minute. The puddled balls are shingled by four steam-hammers; 37 puddling-furnaces are erected, and seven more are in course of building; most of these furnaces are provided with step-grates. This grate is constructed in six steps successively, and as the coal is put in at the top of the steps it gradually falls towards the bottom; the fuel is thus distributed; it does not fall through the bars so much, and less ashes are made than with the ordinary horizontal grate. The step-grate, when the firing is properly attended to, has the advantages of economy in consumption of fuel, and in preventing smoke. The rail-mill engine has one 26-inch horizontal cylinder, 3-ft. stroke, acting direct to two pair of rolls, making 100 revolutions per minute. The second mill-engine has one 28-inch horizontal cylinder, 3½-ft. stroke, acting direct to three pairs of rolls, with a speed of 95 revolutions per minute; this mill is used for rolling heavy bar iron, angle iron, as well as rails. The blooming mill-engine has one 20-in. horizontal cylinder, 2-ft. stroke, on second motion; it drives two pairs of rolls. This mill is provided with a lift, which raises the heavy slabs to the top of the rolls, and is put in motion by a small horizontal engine. In connection with these three mills there are 25 heating furnaces; over 21 of these furnace-boilers are mounted, which are of the elbow form; each furnace heats one boiler; their length is 20 ft. 3 in.; diameter, 4½ ft.; the tube, 2 ft. 1 in. in diameter. These boilers generate steam for the whole of the engines in this department, at a pressure of 40 lbs. per inch.

At the new works, No. 2 forge and one merchant mill are in operation. The No. 2 forge engine has one 36-in. horizontal cylinder, 3½-ft. stroke, on the second motion; it drives a forge train of three pairs of rolls on one side of it, and a forge train of two pairs of rolls on the other side, at the speed of 90 revolutions per minute. The puddle balls are manipulated by four steam-hammers. In this department 68 common puddling-furnaces are erected, without boilers, and seven double puddling-furnaces. The waste heat from these seven furnaces is utilised in raising steam in seven boilers, constructed on the girder principle, patented by Mr. Crowe, the engineer of the works. One boiler is erected over each furnace. The bottom table is represented by a tube 24½ ft. in length, 2 ft. in diameter, the top table by a tube 24½ ft. in length, and 2½ ft. in diameter. These horizontal tubes being connected by a series of vertical tubes 2 ft. 9 in. in length, and 9 in. in diameter. The boiler is set in a flue of zig-zag form, so that the whole of it, excepting the steam space, is exposed to the heat, and the expansion or contraction is uniform in the lower parts of the boiler; this, combined with the small size of the tubes, give it great strength and corresponding safety. The unequal expansion or contraction of the bottom and upper parts of plain cylindrical boilers has not received due attention, and is a serious defect in that form of boilers, making them liable to rupture at the under side; this may to some extent be prevented by a more equal distribution of heat over all parts of the outer surface, and this is the principal element of safety in Mr. Crowe's boilers. It is to be regretted that in the erection of iron works selection is often made of the worst form of boilers to generate steam by the waste heat of the furnaces. The vertical boiler is much inferior for absorbing and utilising heat as compared with a horizontal one; and the former, as they have been constructed, are well known to be highly dangerous. The merchant mill engine in the new works has two 14-in. horizontal cylinders, 2-ft. stroke, direct acting to the rolls, which are driven at a speed of 140 revolutions per minute. There are three mill furnaces, with a boiler mounted over each. The make of this mill includes angle iron, bars of all kinds, hoops, &c. The total produce of the mills is 1000 tons and upwards per week.

The rolls at Tees Side Iron Works are all mounted in pairs, they are not made to be reversing, either by means of a crab and clutches, or by reversing the engine, consequently the iron is rolled in one direction only. We anticipate the system of rolling iron in both directions will become more generally adopted, either by using rolls in pairs, and reversing on the principles named above, or better still by adopting three rolls, and a convenient lift on one side, and have thus a continuous motion in the same direction, both of the engine and rolls. An increase in the stock of rolls will thus be incurred, but when we consider that the arrangement enables twice the amount of work to be done in rolling in both directions, instead of in one only, and that there is a certainty of much better welding of the several qualities of iron mixed in a rail pile to be effected, there can be no question of its advantages. A superficial observer must have noted the inferiority of common rails, caused by imperfect welding of the component parts of the pile, thus producing lamination.

ZINC, AND ITS MANUFACTURE.

A propos of the recent publication of certain statistics of the zinc manufacture by M. Ed. Fuchs, and of the annual report (April, 1870) of the largest zinc-producing company in the world, we purpose to review in brief the history and position of the zinc trade. Although known as a substance whose mixture with copper produced brass, and though worked for this object from the 15th century, the ores of zinc failed to furnish the metal as a branch of industry until the 19th century. In England, so early as the 16th century, the metal was isolated by Paracelsus, but no further advance seems to have been made towards its economic application, until in 1805, after an extensive series of experiments to reduce the carbonate to the metallic state, a Belgian chemist, L'Abbe Dony, succeeded in obtaining the metal by sublimation. The rude apparatus in which Dony first accomplished the condensation of zinc has, with slight modifications, been largely employed ever since, under the name of the Belgian process. This apparatus was no other than a flower-pot, fixed in the side of his furnace, and having a hole pierced through, the better to observe the progress of the operation. In this recess the zinc deposited in little drops. The metallurgy of zinc was known. The flower-pot has been replaced by retorts, provided with moveable horn-like prolongations, in which the metal collects, the number and size of the retorts have been gradually increased, but the process remains to this day substantially as Dony left it.

Simultaneously with Dony's invention at Liége, a similar process was discovered in Silesia. The sinkings for coal at Tarnowitz had disclosed vast beds of calamine, which though inferior in point of purity to the Belgian ores were of sufficient importance to create a new and flourishing industry. Here the reduction of the ore, previously pulverised and mixed with ground coal, was accomplished in a muffle, terminating at its upper extremity in a tube, which passed through an aperture in the side of the furnace, and, bending downwards syphon-wise, allowed the condensed metal to flow out. The syphon form has, however, been abandoned in favour of a series of double recesses, in which the zinc collects, and is removed by a descending pipe into cast-iron cups. A third method was practised for some time in England, known as distillation *per descensum*, in which the ore was reduced in retorts or crucibles arranged on the shelf of a furnace of the ordinary glass-house form. Through the bottom of each crucible a pipe descended to the cool cavity underneath. This opening in the bottom of the crucible was closed at the commencement of each operation by a wooden plug, which, becoming converted into charcoal by the heat, allowed the zinc vapour to percolate through its pores, and run down the tube into the receiving vessel. This system, though it is said to yield good results, is wasteful in fuel, and is now generally abandoned in favour of one of the processes before mentioned, or some modification of them.

The first zinc works was established at Liége, by Dony, in 1807. It was supplied with ore from the calamine beds of Moresnet, of which he had obtained the lease. But Dony paid the price of most inventors—he enriched the world and impoverished himself. Finding the demand for the new metal increase so slowly, and his resources gradually diminishing, he was at length obliged to sell the lease of his rich zinc mines, after having worked them for eight years. These deposits of zinciferous carbonate have since acquired a world-wide notoriety in the hands of the Vieille Montagne Company.

The mining of the ores of zinc is by no means of so recent date as its metallurgy. So early as 1425 the annals of the Duchy of Limbourg mention the calamine explorations of Altenburg; and for a long time blende and carbonate of zinc have been mined, as secondary products, in Rammelsberg and other parts of the Hartz Mountains. The chief ores for industrial purposes are blende, a proto-sulphuret, and calamine, a carbonate of zinc, having very frequentiy an admixture of silicate. Though theoretically richer in metal than the carbonate, blende is more difficult in its treatment, and yields a less percentage to the manufacturer. The carbonate occurs both in veins and beds, in the Devonian measures of Ardennes, the Hartz Mountains, and the Erzgebirge, and among the limestones of Derbyshire and Cumberland, and in the transitional rocks of Hungary and Silesia. It sometimes forms the lining on the cheeks of lead veins, and sometimes is associated with the galena, in which case it is never very dependable, its continuance being often abruptly supplanted by blende, galena, or pyrites. This is especially the case in the zinc mines of Spain and in the newly-opened workings in Sardinia. Blende occurs chiefly as an alternative in lead mines, and sometimes in copper and other metalliferous veins, but it is occasionally found in masses, like the Cornish "floors" or the German "stockwerk," as in the rich mines of Iglesias, in Sardinia, and of Stollberget and Ammeberg, in Sweden. Above half of the zinc ores of Europe is supplied by Prussia. In Silesia there are 30 mines in operation, partly worked by shafts and partly by levels driven into the hills. They employ 15,000 workmen, and yield annually 221,000 tons of calamine. In Westphalia 70,000 tons are supplied from 75 works. The Rhine ores consist of blende, largely mixed with lead and iron. In some parts the iron reaches

18 per cent. of the calcined ore, but no effort has yet been made towards its utilisation. Here 6000 men are employed. Belgium, the oldest zinc-producing district, supplies 57,000 tons, Poland 12,000 tons, and Spain 50,000 tons. These ores are chiefly the carbonate, containing portions of blende and galena. France contributes 3000 tons, and Ammeberg, Sweden, 12,000 tons. The sulphuret from these Swedish mines is very pure, and admits of tolerably easy reduction. From Iglesias 20,000 tons come. This district in Sardinia has but recently become a producer of calamine. In 1866 the total quantity raised was 13,000 tons; increased in 1869 to the amount given above. Immense stores of calamine enrich Sardinia, and the supply seems to be only limited by the difficulties of transport, which, it is said, will prevent the annual yield from exceeding 40,000 tons. These Sardinian deposits are regarded as the only carbonates at all comparable, in point of purity to the far-famed calamine beds of Moresnet and Tarnowitz. America produces about 12,000 tons; but the disorganisation of the civil war interrupted the annual reports after 1863 until recently. In Italy and other countries, including England and Algeria, where, at the present moment, a Belgian company is preparing to open out a zinc mine, 12,000 tons are raised.

In the metallurgy of zinc, the first point to be accomplished is its slow and uniform roasting. This is effected at present in a furnace, whose sole is divided into two or three compartments, of varying heats, and the ore is drawn from the first to the next, at intervals of about eight hours, in such manner that the mineral is first gently heated, and gradually increased to the utmost power of the furnace. A self-acting machine has been invented by M. Gerstenhöfer, to avoid the immense hand labour involved in this operation. This apparatus is used in England and Belgium to some extent, but does not seem to fulfil all the desirable conditions, and the ore calcined is neither so uniformly nor so thoroughly roasted as by the hand method. From the calcination the ore is carefully ground, and mixed with coal dust. Coke dust is used in Silesia, to avoid the stoppage of the pipe that delivers the zinc from the muffle, by the adhesion of the tarry matters of raw coal. Here very little labour is required from the workmen; the zinc continues to condense and flow down the syphon to the end of the operation. In the Belgian process, however, when the ore has been placed in the retorts, and has begun to sublime, the horn-like prolongations are taken off every two hours, and carefully emptied into the receiver. The fact that this method requires a lower temperature than the Silesian process has been utilised in arranging some Belgian retorts above the ordinary Silesian furnace. This method has been established at the zinc works of Valentin Cocq, with a considerable economy of fuel. The cost of the Belgian and Silesian processes is about equal, the first having an advantage in fuel, and the second in hand labour and in the longer endurance of the furnace. The points to which attention is directed to reduce the cost of zinc production are, to augment the yield by increasing the size and number of the retorts, and to reduce the amount of fuel consumed. In the Belgian furnace it is customary to arrange 70 retorts, and from 30 to 40 in the Silesian, the daily yield amounting respectively to 11 cwts. and 20 cwts. The fuel required in the Silesian furnace is 2½ tons of coal per ton of ore. Three-fourths of the metal contained in the ore is by these means extracted. With the object of still further reducing the expenditure of fuel, which in Prussia and Belgium is more costly than with us, various forms of grate have been tried for the reducing furnaces, with but partial success. An English patent taken out some two or three years ago, by Messrs. Tildesley and Bird, seems to us most likely to answer the purpose. Furnace grates similar to Siemens' are used with moderate success in France and Silesia.

The metallurgy of zinc, like its mining, is confined to a few centres. In England the principal works are those of Messrs. Vivian, at Swansea, and these depend partly on foreign supplies of ore. The entire produce of Europe is 120,000 tons; of this Prussia contributes 80,000. The largest of the Prussian works is the Silesian Society of Mines and Foundries, which keeps in activity no less than 150 furnaces, and turns out annually 8000 tons of raw zinc, and the same quantity of sheets. The cost of the reducing operations at these works is 11s. 10d. per cwt. of zinc produced; and the selling price at the market town, some miles distant, has been for the average of the last few years 22s. 4d. per cwt. The extra cost for rolling is 1s. 3d. per cwt. of sheets. This price is slightly augmented in the case of the thinner varieties. The largest zinc works in the world is La Vieille Montagne, near Liége. Last year this company raised 68,379 tons of ore, and in their own two collieries 89,452 tons of coal, while the total manufacture of zinc attained the amount of 44,441 tons, of which 35,213 consisted of sheets, 5965 of zinc-white, and the rest of various castings—ingots, wire, nails, ornaments, &c. The entire sales of this company last year, according to the official report of April 30, 1870, amounted to the sum of 1,000,000*l.*, being 30 per cent. of the entire produce of Europe, and resulting in a gross profit of 212,557*l.*, which allowed a dividend to be declared of 25 per cent. on the capital. At these works sheet-zinc is rolled to any thickness. The plates are rolled at a temperature of about 212°, which heat is generally developed by the pressure of the process. The specific gravity is thereby increased—from 6·8 to 7·2.

Two-thirds of the total quantity of zinc produced is manufactured into sheets, the remaining one-third is employed for brass making, for wire, for zinc-white, as a substitute for lead in paints, and for castings, which last, by the way, are made in moulds of iron instead of sand, thereby attaining a cleanness and finish before unknown, besides considerably reducing the expense of manufacture. That the consumption of zinc is far from having attained its normal development may be seen from the fact that while France consumes 35,000 tons annually, and Great Britain and her colonies 30,000, and Belgium 6500, Germany uses but 22,000, Italy, Russia, Spain, and other countries together only 10,000 tons. The two chief requirements for zinc sheets are roofing and sheathing the bottoms of ships, the usual thicknesses for roofing purposes being from ·028 in. to ·044 in., while for ships' bottoms they range from ·038 in. to ·048 in. Mr. Daft, an English engineer, has recently proposed an ingenious application of zinc sheeting to iron ships, whose chief advantage seems to be the avoidance of vegetable and animal growths on the bottoms of vessels by means of the galvanic current set up between the two metals when in the presence of salt water.

STEAM-BOILER EXPLOSIONS.

Sir,—There appears to be a growing disposition on the part of a small body of persons to endeavour to procure governmental inspection for steam-boilers, and if it could be shown that such inspection would prevent the loss of the few lives attributable annually to the explosion of boilers I would not say a word against the official supervision, but I do not believe such a result would follow. Of all accidents that occur in connection with industry I consider boiler explosions the most purely accidental, for we find that occasionally an almost new boiler, by an undoubtedly good maker, will explode, and only recently—a fortnight since, I think—an accident was reported in the *Mining Journal* within six hours of setting a newly-repaired boiler to work. In truth, we know very little about the cause of boiler explosions, and I am inclined to think that it has much more to do with the condition of the water than with the boiler itself. Just as the same flame will emit light rays and heat rays simultaneously, and as the proportions of one to the other vary according to the source of the flame and conditions under which it is produced, so I believe that even the same water (that is, water from the same source) will generate steam of distinctly different characters at different times, so that at one time the steam space may be filled with a comparatively harmless vapour, and at another with a vapour that is, as it were, spontaneously explosive. It may be that the water is in a different electrical condition, or that the molecules are not always packed equally tight, and, therefore, will sometimes generate steam with dangerous rapidity; but there seems no doubt that for some cause or other a boiler safe at one time is not so at another, and it would be much better for scientific men to enquire into this than interfere with practical work.

The only efficient remedy that I can see for these calamities is the separation of the water space from the steam space, as was done in the boiler of Dunn, of Manchester. The advantage of this arrangement is that the strength of the steam space could be increased to any extent without materially augmenting the first cost of the boiler. The great objection to both Dunn's and Howard's boilers is that they have too many joints, but the separate steam space could be provided either with the ordinary Cornish boiler or with the internal flue boiler, and I do not think there would be any great difficulty in modifying a large majority of the existing boilers to meet this view. In all cases the boiler proper and a portion of the tubes connecting it with the separated steam space should be filled with water, as by this means there would be few joints to keep steam tight, and the liability of explosion would be reduced to the minimum. There would be no difficulty in introducing arrangements within the water space to secure the proper circulation of the water, and the inconvenience of incrustation could thus be avoided. D. T.

UNITED STATES PATENT LAW REFORM.

Sir,—It will no doubt interest your readers to know that by an Act of Congress passed on July 8 some important modifications were made in the law relating to patents for inventions. By this Act, also, foreigners are allowed to take out patents for designs, which will, no doubt, prove a great boon to the commercial community in this country. There is also a provision made for the registration of trade marks. It would take up too much of your space to quote in full all the new parts of the law affecting Englishmen—we, therefore, simply add the main features:—

1.—The law which required foreigners to put and continue their inventions on sale in America within eighteen months after obtaining their patents has been repealed.

2.—The law permits a foreigner to patent his invention in the States after it has been introduced and patented abroad for years, provided it has not been used in America for more than two years prior to the application for a patent.

3.—Models are not now required when the invention can be illustrated by drawings in such a manner as to be understood by the examiners.

4.—The drawings of patents, being now all photographed, may be had at a very small cost.

5.—Under the new law foreigners may take out patents for designs. The term varies from three years and six months to fourteen years, at the discretion of the applicant, the fees being, of course, proportionately increased according to the number of years applied for.

6.—Foreign industries may now be protected by the registration of trade marks, and reproduction in America, without the consent of the inventor, prevented.

Chancery-lane, Sept. 26. Hughes and Son.

PRODUCTS OF MINING REPRESENTED AT THE RUSSIAN INDUSTRIAL EXHIBITION AT ST. PETERSBURG—No. I.

Sir,—Some time ago I gave you an account of the iron industry of Russia. The National Industrial Exhibition now being held at St. Petersburg, which is the most comprehensive one that has ever taken place in Russia (containing 3000 exhibitors, and covering an area of 21,000 square yards), enables me to contribute to your pages particulars regarding other products of mining for which Russia is justly celebrated, but which are little known in this country, owing probably to the fact that they have in no way as yet affected our markets. This state of things, however, cannot be of long duration, for a new era is evidently fast approaching—the era of railways, the construction of which, encouraged by the Government in the shape of guarantees, is being prosecuted with an energy quite new to an empire whose material prosperity is only now beginning to assert itself. Among other lines projected is that over the Ural Mountains to Siberia, which will render the riches of those immense territories of easy access to the markets of Western Europe. I may here state that the iron industry, since my last communication, of February, 1869, has experienced a marked change for the better, the impetus given to railway construction having greatly contributed to its resuscitation. The products of mining shown at the Exhibition consist of ores, and their manufactures of iron, copper, gold, silver, platina, lead, tin, plumbago, precious stones, coal, mineral oil, and salt. They are exhibited both by Government and private establishments. Of the former in connection with the iron industry should be noticed one of the principal sources—the mines of Mount Blagodait, situated in the province of Perm, on the Ural, in the circle of Verkhotoorye. The exhibits consist of a collection of samples of ores of magnetic oxide and their vein stones, also brown iron ore. Mount Blagodait was opened in the year 1730, and supplies yearly 2,000,000 poods of ore, which is smelted on the Swedish system. Of the private exhibitors, the most important one is Mr. Paul Demidof, whose fabulous wealth, acquired chiefly by mining enterprise, is proverbial, not only in Russia but throughout the whole of Europe. The exhibits consist of ores of magnetic oxide and their vein-stones, brown iron ore, besides dolomite, sienite, fire-clays, limestone, and manganese, all obtained on his estates. Mr. Demidof's mines, blast-furnaces, and works constitute whole mining districts, comprehending as many as 11 separate establishments. They smelt, in the aggregate, 3,188,590 poods [1 pood =36 lbs. English, 62 poods=1 ton] of ore yearly, out of which is obtained 2,128,040 poods of cast-iron, which is manufactured principally into sheet-iron, bars, and rails. The extent of production may be deduced from the fact that 11,000 workers are employed, and the consumption of charcoal is yearly 190,000 koros (4½ cubic yards), and of wood 50,000 cubic sajens, of 7 feet. The other exhibitors of the Ural, both Government and private, who, like Mr. Demidof, are also iron manufacturers, exhibit different ores, in their natural state and roasted, principally magnetic oxides, brown iron ores, chrome ores, fluxes, scoria, &c. Other districts of European Russia are also represented at the Exhibition. The Viatka Government Mines and Works, in the province of that name, exhibit ores and fluxes; and the Olonetz mining district of the latter province, including a part of Finland, shows specimens of fire-clays, and fire-bricks manufactured of the same, also ores used specially for the production of iron employed in the manufacture of ordnance.

From the South of Russia there is no evidence that the new industry—that of manufacturing iron with coal fuel, which is so abundant in the basin of the Don—has been successful. I mentioned in my last paper that great expectations were held out concerning the economical production of iron in this part of the country. A few exhibitors from Finland show some interesting specimens—more than 24 descriptions of lake and bog iron. One iron manufacturer in that country leases as many as 33,334 square miles of lakes, from the beds of which he obtains 1,200,000 poods of ore yearly. Poland, although a large producer of iron, is poorly represented as regards specimens of its ores. The only article which we import from Russia in the shape of ore is chrome ore. The following were the exports from Russia in 1867 to this country:—To London, 72,398 poods; Hull, 56,243 poods; West Hartlepool, 70,056 poods; Wisbeach, 5040 poods; Grimsby, 17,010 poods; Newcastle, 17,115 poods; Lynn, 3150 poods; Yarmouth, 3150 poods; Lowestoft, 2835 poods; Sunderland, 25,560 poods; Stockton, 1950 poods; Berwick, 1410 poods; Dundee, 44,140 poods; Leith, 76,264 poods; Aberdeen, 3150 poods; Montrose, 4410 poods; Kirkaldy, 23,178 poods; Grangemouth, 13,249 poods; Abroath, 6970 poods: total, 436,258 poods (7360 tons 8 cwts. 1 qr. 12 lbs.)

The next article of importance on the Ural after iron is copper, which, like the former product, is found in the provinces of Perm, Ufa, and Orenburg. The following are the principal exhibitors whose productions are well known in Russia, and for some of which prices are regularly quoted at St. Petersburg:—

Mr. Basile Pashkof, of the province of Ufa, exhibits specimens of red bar copper in its different stages of manufacture, materials used in smelting, and the intermediate products of smelting copper. The price, pure copper, is quoted at (1 rouble=2s. 8d.; 1*l.*=7 rs. 50 cop.) 12 rs. 50 cop. per pood (4*l.* 19s. 3d. per cwt.) The above was produced at the Bogoyavlensky Works, established in 1752. The yearly production is 6000 poods of copper, of the value of between 70,000 and 80,000 rs. The ore is obtained from the neighbouring Government of Orenburg to the extent of 200,000 poods yearly, and the number of workmen employed is 1000.

Mr. Paul Demidof, of the province of Perm, Verkhno-Toorinsk Circle, exhibits samples of red copper ores and their vein stones, from the Mednoroodinsky Mine, limestone, pyrites, &c. Malachite in blocks, at 125 rs. per pood (1033*l.* 6s. 8d. per ton); powdered malachite, used as paint, 12 rs. per pood (99s. 3d. per cwt.)

Countess Alexandra Kossakofsky, of the Government of Ufa, Sterlitomansky circle, exhibits samples of copper ores, and pure bar copper produced at the works, established 1752. The yearly production is 5000 poods of copper, of the value of 55,000 rs. The ore is derived from the Karigalinsky Mines, situated fifty miles from Orenburg. The number of workers employed is 480.

There are also exhibitors from the Siberian side of the Urals. Mr. Popof, of the Semipalatinsky district, of the Kirghize Steppe, has an extensive collection of specimens of copper ores, in combination with silver-lead, obtained from the following mines:—Alexandrofsky, Nikolsky, Samosibetsky, Abalinsky, Soratube, Yassibai, Jajai Kara, Tsarevo-Alexandrofsky, Troitsky, Kornilofsky, Alexayefsky, Oospensky, Annensky, Alekasorsky, Akuzeku, Dzusalinsk, and Bogoslovsk. Nearly all these mines having been but recently opened and worked, the yearly production, considering the number of the mines, is not extensive, being estimated at only 400,000 roubles, and the number of workers at 600. Madame Anne Riasanof, of the Akmolinsky territory, of the steppe of the Siberian Kirghizes, exhibits specimens of copper ores, blue and green carbonates, native copper. Samples of minerals found in the Akmolinsky territory, products obtained in the smelting of copper, copper bars, at 11 rs. per pood (91s. per cwt.). The production of copper at the Spassky works is 11,000 poods yearly; the number of workmen employed, 236.

The working of copper is an old industry of Russia, that metal still entering largely into the material used for the manufacture of various household utensils. It is also extensively used in the shape of coin. The Ekaterinburg Mint of the Government of Perm, in Siberia, which was founded in 1734, exhibits a collection of copper money, coined at that establishment, which produces copper currency, of the value of 1,750,000 rs. yearly. The raw copper to the extent of 36,000 poods, is annually received at the mine in the form of a Government tax from private works, partly in old coin, the remainder is purchased from private mines. The steam and water-power is equal to 250-horse power, and 336 workmen are employed.

Several exhibitors of copper from Finland are also conspicuous, the most considerable of which are Messrs. Joffriot and Co., of the Pitkarandi Works, in the Government of Vyburg. They exhibit bar copper at 12 rs. per pood (91s. per cwt.) The yearly production is 6000 poods of copper, of the value of 125,000 rs. The ore is obtained from mines at a depth of 8 sajins (56 ft.), and the number of workmen employed is 800. Another exhibitor, of the Government of Uleaborg, shows specimens of Finland copper ore containing from 20 to 22 per cent. of pure metal.

The export of copper from St. Petersburg to all countries was in 1855—284 tons; 1856, 2467 tons; 1857, 2455 tons; 1858, 501 tons; 1864, 625 tons. The export of copper to Great Britain alone for nine years was of the following value:—1856, 26,384 rs.; 1857, 74,000 rs.; 1858, 49,000 rs.; 1859, 88,000 rs.; 1860, 1000 rs.; 1861, 51,000 rs.; 1862, 1000 rs.; 1863, 1000 rs.; 1864, 85,000 rs. Notwithstanding the home supply of this metal, there is a demand for Burra Burra copper, which is regularly quoted in the price list of the St. Petersburg Exchange. The iron and copper mines of the Ural Mountains had long been considered among the most valuable sources of the national wealth, when in the middle of the eighteenth century it was discovered that gold mines also existed there, and in 1754 an essay was first made to work them. The quantity obtained was small. The first mines discovered and worked were those of Ouktoussa, on the banks of the Issit, and those of Berezof, 15 miles north-east of Ekaterinburg. The gold in the latter place was obtained from quartz rock, and in 1824 alluvial deposits were also discovered, both of which have been worked ever since. The Beresof Mines are represented at the Exhibition, where are displayed specimens of quartz, with veins of gold from the Ouspensky workings, and sands containing gold from the Alexandorfsky diggings. The production of these mines in 1869 was 27 poods 14 lbs. 32 42-96 z., (985½ lbs. English), of the value of 228,475 rs.; the number of miners engaged 923; there were besides 34 overseers and 96 apprentices. At the mines two steam-engines and two over-shot water-wheels are brought into requisition for the necessary operations. James Rushforth.

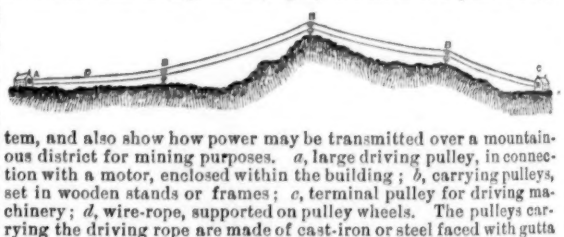
82, Farleigh-road, Stoke Newington.

MINING MACHINERY: TRANSFER OF POWER—No. III.

HIRN'S TELODYNAMIC SYSTEM.

Sir,—The horizontal shaft has been from time immemorial, and will always be, the connecting link between factories on a large scale and the motors which are in their immediate vicinity; but its merit will be restricted to this condition, and in no way could it be rendered applicable for the purpose of transferring power hundreds and thousands of yards.

Hirn's telodynamic system, first applied at Logelbach, near Colmar, in 1850, accomplishes, however, the latter object, and since the apparatus is now largely employed, and is of great cheapness and simplicity, it may be thoroughly accepted for mining purposes. To the ordinary observer the system will appear as an exact reproduction of contrivances seen in factories—viz., pulleys set in motion one by the other, and a small rope taking the place of a leather belt—but the immediate principle involved in the arrangement, is the transfer of power at an enormous velocity, and after transmission the re-conversion of this velocity into power without any very sensible loss of effect. The arrangements (Fig. 1) will serve to explain the system, and also show how power may be transmitted over a mountainous district for mining purposes. *a*, large driving pulley, in connection with a motor, enclosed within the building; *b*, carrying pulleys, set in wooden stands or frames; *c*, terminal pulley for driving machinery; *d*, wire-rope, supported on pulley wheels. The pulleys carrying the driving rope are made of cast-iron or steel faced with gutta percha. Their diameter and strength, as well as that of the rope, must vary according to the power which has to be transmitted. The speed of the wheels at the circumference is from 60 to 100 feet per second. Higher speeds are attainable, but are not recommended.



The loss sustained in the telodynamic system is very trifling; it is, in fact, reduced to resistance of air against the arms of the pulleys, the rigidity of the wire-rope in its passage over the pulleys, and the friction of the pulley axles. According to numerous experiments, the loss in cases where distances are not so great as to require supporting pulleys is 2½ per cent. Thus, for instance, two pulleys 12 ft. diameter, making 100 revolutions per minute, with a rope ¼ in. diameter, can, by means of a circumference speed of 66 ft. per second, transmit 120-horse power to distances between 40 and 150 yards, without occasioning a loss of more than 2½-horse power in effect. This loss may be regarded as constant, when it is not necessary to have recourse to support pulleys. But whenever the distance is so considerable as to require these pulleys, then each of them will add its part to the amount of loss indicated.

The cost of driving and carrying pulleys with stands, or supports, for the transmission of 120-horse power is about 200*l.* for every 1000 yards. This system of transmitting power has been employed at many hundreds of places on the Continent, among which may be noticed—At Copenhagen, 45-horse power is transferred a distance of more than 1000 yards. At Cornimont, 50-horse power is transmitted a distance of 1258 yards. At Oberursel, a force of 100 horse power is carried 1076 yards. At Emmendingen, 60-horse power is set in motion at a distance of 1312 yards from its motor. At Schaffhausen, 540-horse power is transmitted by two ropes across the Rhine, a distance of 385½ feet, thence in a different direction of 1431 feet, the ropes being driven by three turbines, of 600-horse power. The following are some of the principal dimensions of the apparatus and connections in use at Schaffhausen:—

Available fall at low water below dam, about	Feet	16 0
ditto high water ditto		12 0
Outside diameter of turbines		9 0
Efficiency		70 p. cent.
Diameter of the rope pulleys		14 3
Diameter of the rope		0 1
Speed of the rope in feet per second, about		64 0

The rope is run so that the driving or light side is undermost.

Some time ago the writer designed gear for transmitting 45 and 20-horse power respectively, which included the following data:—

	45 horses.	20 horses.
Maximum speed of rope per second	Feet 90 0	Feet 90 0
Diameter of pulleys	9 9	6 6
Diameter of carrier wheels	6 0	6 0
Extreme distance between carrier pullies	180 yds.	180 yds.
Circumference of transfer rope	1 inch	2¼ inch.
Duration of charcoal wire-rope working (say) 10 hours daily	3·4 years	3·4 years.

The telodynamic system is not applicable to the purposes of trans-

ferring power from surface to underground headings, but for utilising and transmitting power derivable from rivers or steam-engines it offers to the miner many advantages. There are many instances where dressing and winding machinery might have been driven by telodynamic wheels and rope, instead of applying directly the more costly arrangements of steam machinery. X.

THE RATING OF MINES.

SIR,—The questions which have cropped up respecting the rating of mines in Staffordshire are too important to slip by without some little attention from those more especially interested in the problem. This question has been considered in a variety of forms; much wordy warfare has taken place, editors of newspapers have given us leaders on the subject, and Mr. Goschen (the head of the Poor-law Board) has been looked to as the right man to put the question at rest, by introducing such a clause into his new Valuation and Rating Act as will leave no doubt as to the course or line of action for overseers and assessement committees to take in making rates and deciding disputes on such subjects. The Act of Queen Elizabeth provides that coal mines shall be rated at what they are worth to rent from year to year; and as no Act has ever negatived or touched such powers, it is argued that a competent valuer ought to be called upon at least once a year to view each pit or mine, and say what it is worth to rent for the next year, taking it as it is, with all its engines, railroads, &c., under and above ground. The next point is also considered clear—that of rent for damaged land. We are assured that, although it has been a regular custom for the lessee of mines, coal and ironstone, to pay rent for damaged land, independent of the royalty paid per acre or per ton for coal and ironstone, or sleeping minimum rent, as a rule the overseers have neglected to rate the damaged land; and as that quantity has from year to year been taken off the rate-book, it forms a subject of complaint in nearly every mining parish where mines and quarries are carried on. In some places a fixed price seems to have been settled upon—5*l.* per acre; in other parts double the common agricultural value, &c.; and in all cases the land has to be levelled at the end of each lease, and re-soiled—in fact, restored for agricultural purposes—or a fine paid equal to the value of the land per acre before it was broken for mining purposes.

In the Brierley Hill and Birmingham papers our attention has been repeatedly called to unpleasant meetings on this great rating question, the *general* ratepayers contending that every property ought to be rated according to law—which is, at what it is worth to rent from year to year; while the opposing party (the coal owners), who seem to be the strongest party, are reported to have dictated their own terms as to the rateable value of their coal mines for a long period, and have never paid *any rates at all* on the damaged land they rent about their collieries, stone pits, &c.

Taking all these statements to be correct, we will ask on what ground the valuer must base his valuation to rent from year to year? Is he to consider at what cost the mine has been opened, the great or small amount of capital sunk in the erection of engines, or sinking the pits. The argument is that no valuer asks what it cost to erect farm buildings, or what the farm cost, in order to enable him to fix the assessment. No; he first enquires the rent the tenant pays, and if he has a lease the terms of that lease, &c., and fixes his value on each farm according to its worth to rent as he sees it. The farmer may, perhaps, argue that he has done his erections at his own cost, expended from 1*l.* to 5000*l.* in improvements. The valuer's answer to that is, "That outlay was considered in your rent at the time you took it, therefore the rateable value is greater than your rent." The same argument applies to collieries: a man takes 1000 acres of coal at *one-sixth* or *one-tenth* (or some other price, as the case may be) of the selling price of the colliery, loaded with trucks, boats, carts, or wagons, but before he can sell any he has to sink pits, erect engines, &c. Will a man give a sixth, and expend his 60,000*l.* in sinking pits? If so I, as a valuer, must consider how much more I would give for it when the mine is open, and the coal in the market. The same rule applies to all and every other description of property. A man may purchase a property in this great city, which property is not, as it stands, worth 500*l.* a year, but he expends his capital upon it, and he soon gets a rent of 5000*l.* a year. The same rule applies to all and every description of rateable property. The writer thinks that the proper way for overseers to do is to have property rated on what it is worth to rent from year to year, collieries included, and all engines and buildings about ironstone and other quarries and pits not so rated, and damaged land according to the rent paid for such land in each district. If Mr. Goschen makes the law more clear on this rating question he will confer a great boon on every ratepayer, coal, and mine holder in the kingdom. READER.

Sept. 27.

THE TRUCK SYSTEM.

SIR,—The proposition to remedy the evils of Trade Unionism by affording trades unionists the benefit of legal recognition, and subjecting them to regular supervision to neutralise their power for ill, has been so favourably received that it is, perhaps, worthy of consideration whether the truck system could not be dealt with in a similar spirit. That the system of truck has its advantages as well as it objections is admitted throughout the country, and it is daily becoming more generally acknowledged that it is not the desire for gain that induces the masters to recognise the tommy-shop. The great wish of the masters is that a fair proportion of the wages earned by their workpeople should be applied by them to the support of their wives and families, instead of being squandered in the beer-house. Nor is this altogether philanthropy on the part of the masters; it arises from another cause. They know that what has been termed the "fraud of improvidence," so common amongst the workmen, inflicts a very serious tax upon the masters, and benefits no one except the sellers of intoxicating drinks; and the tommy-shop certainly does something towards securing attention to home comforts, although the abuse of the truck system in many instances rendered the stringent legislation now in force concerning it absolutely necessary.

But the question is whether the advantages without the evils of the truck system can be secured by some improved legislation upon the subject. As a fundamental principle, the keeper of the tommy-shop should be appointed and dismissible by the men, the men guaranteeing on their part the safety of the stock, whilst the masters should be legally entitled to pay the tommy-shop coupons in lieu of cash (to the extent of the workman's purchases) in settlement of wages earned. The tommy-shop would thus have all the advantages of a co-operative store, and as the goods would be received in advance of payment of wages there would be no fear of all being spent in drink. The master's interest in the shop would consist in receiving 5 per cent. profit upon all purchases made for the shop, and all realised in excess of this should be applicable by the men first to the payment of the storekeeper, and afterwards for distribution amongst the purchasers in proportion to the purchases made by them. Of course, rent, gas, and incidental expenses would be paid out of the receipts before estimating the profits. As the men guarantee the safety of the stock, the representative of the master should be required to give notice to the storekeeper when any man has earned less than three-fourths of his average daily wages.

The sale of intoxicating liquors by the storekeeper should be prohibited, and the men's committee, for their own safety, should order the storekeeper not to supply goods to more than three-fourths of the average earnings of the men receiving the accommodation. Thus, they would say—"Limit puddlers to —s. —d.; underhands to —s. —d."; and so on, in each week. By this arrangement the men would secure their supplies at 5 per cent. upon wholesale cost price; they would have an abundant supply of necessaries between the pays, and something for pocket money, and for supporting their Unions when the pays came round. The object of the masters would be attained in keeping the workmen's families in a prosperous condition, and the men would have all the advantage of ready money without present arrangements being interfered with.—*Sept.* 29. R. T.

RELATIVE MARKET VALUE OF PROGRESSIVE MINES.

SIR,—This often-discussed question has once more been re-opened in your columns by the letter which appeared last week. But your correspondent has not only signally failed to throw any light upon the subject, or even adduced a single reason to account for the known anomalous disparity; but the instances which he quotes are altogether apart from the subject, simply because at least four out of the mines named do not possess any market existence. This is the more unfortunate, seeing that one—which certainly is not known upon the market—is brought out and compared with another, the shares in which can be readily dealt in at ⅛ difference between buyers' and sellers' quotations. What becomes of the value of such comparisons, when the very bases upon which they are made have no foundation in fact? If your correspondent is desirous—as is too apparent—of extolling the merits of one mine at the expense or disparagement of another, he would most assuredly best secure his purpose by adopting other means than a comparison of the market value of the respective mines, when one of the mines with which the comparison is made is altogether unknown upon the market, and, therefore, can have no market value. It is a pity that a question, already difficult and inexplicable enough, should thus be sophistically trammelled.—*Sept.* 27. A COUNTRY INVESTOR.

RELATIVE MARKET VALUE OF PROGRESSIVE MINES.

SIR,—I noticed in last week's Journal a letter from Mr. William Marlborough, in which he estimated the market value of the Rhydtalog Mine at 24,000*l.* Allow me to inform Mr. Marlborough, and anyone else interested, that although the nominal capital of the company is divided into 12,000 shares, the directors have decided on the issue of 8000 only, retaining the remaining 4000 as a reserve, upon which capital may be raised at any future time if it is required. The shares being quoted at or about 2*l.* per share, the market value is 16,000*l.*, not 24,000*l.*—*Sept.* 28. A SHAREHOLDER.

MINING IN MONTGOMERYSHIRE.

SIR,—Within the last month I have spent a few days in the mining districts of this county, especially in the neighbourhood of the celebrated Van Mine, about 2½ miles north of the town of Llanidloes, and was much pleased with the workings and general appearances of the different mines which I had the pleasure of visiting. In wandering a little further north of the Van Mine, I came upon a number of miners' workings, in a valley remarkably fertile, consequently well sheltered from all winds, and well watered by a magnificent river flowing down to the Severn, on its way to the mighty deep, and just by the side of the stream are the workings alluded to. By means of cross-cuts being driven from the side of the high hill the lodes have been intersected, carrying their course parallel with those of the Van Mine, and from the summit of the mountains the mines may easily be seen, each vieing with its neighbour for their eastern and western riches. As I have no public reports to make of any of the mines working, I will confine myself at present to those in the vale. They are held under a tack-note, with a lease to follow when applied for, on very easy terms, comprising two farms, of about a mile in length, and half a mile wide, upon the course of the lodes. Should they meet with their expectations it will ere long prove a most valuable property. Three lodes have already been discovered, although neither cross-cut exceeds but a few yards—consequently, the mine can be easily worked, and with little capital, the river and road passing the foot of the mountain, into which the cross-cuts are driven. The mine is about a mile and a half from the railway now being made from Moat Lane Junction to the Van Mine, by Tref Eglwys village. I shall be most happy to render further information or assistance to anyone who may be desirous of embarking with me and my friends in the North Van Mine.

In next week's Journal I hope to give a review of the different mines of Cardiganshire, from the eastern part of the county to the western, beginning at or about the Plynlimmon, Ponterwyd, and other mining districts.

Aberystwith, Sept. 26. SAMPSON TREVETHAN.

[For remainder of Original Correspondence see to-day's Journal.]

THE BRITISH ASSOCIATION.

GOLD IN WALES.

Mr. T. A. READWIN, F.G.S., read before the Geological Section a Note on a Merionethshire Gold-quartz Crystal and some Stream Gold found in the Rivers Cani and Mawddach, near Dolgelly.

The crystals which he produced he said he picked from a large heap of quartz near Bala Lake, in 1863. At the time it was quite transparent, though tinged slightly with golden-yellow, and under the microscope the colour entirely disappeared. The stone on which the crystal was found was labelled, and put away in his cabinet, with other gold associations of interest, and lay there unnoticed till last year. It had then become more opaque, and, consequently, of more interest to him. It has now all the appearance of a solid crystal of gold, and for which it has been frequently taken. The colour is pale, but he had observed that all gold found in quartz in that locality is light coloured, owing to the presence of a large percentage of silver, sometimes as high as 20 or more per cent.

He referred also to some ounces of water-worn gold, some pieces weighing from 20 to 30 grains, recently found in the Cani, a tributary of the River Mawddach, north of Dolgelly, and also to a very rich specimen broken from a quartz lode at Gwynfynydd, adjoining the Cani and Mawddach rivers. He said that he desired chiefly to bring under the notice of the Section as mineralogical facts the change of the crystal—that gold where the crystal was found is of 14 carats fine, that from the quartz vein at Gwynfynydd 18 carats, and that from the Rivers Cani and Mawddach 23 carats fine. He instanced these as facts, open to a good deal of interesting speculation.

ON KNOWN ASSOCIATIONS OF INORGANIC SUBSTANCES.

By T. A. READWIN, F.G.S.

There are found scattered up and down our unsatisfactory mineralogical literature about 1000 so-called mineral species, and over 1500 varieties: 250 or more of these are of doubtful character, and might, I think, be struck out of the list of minerals altogether. Dana, in his last (1868) edition of his "System of Mineralogy," mentions 838 species, and, at the same time, very properly expresses his doubts of many of these. The (1870) "Index to the Collection of Minerals in the British Museum," names 634 species, and 682 varieties, as contained in that magnificent collection. Three years ago I hastily published the best list of minerals that I could compile. This list, thanks to good and ill nature combined of criticism, and the assistance of friends, is much improved, and I have now succeeded in compiling an alphabetical list of the minerals of the books, and from that list I have arranged a basic list, to which are attached the most reliable published analyses, both British and foreign. From these analyses I have constructed a table which shows at a glance the known mineral associations. I by no means vouch for the absolute correctness of these relations even so far as they go, for I know much to the contrary; but of this I am quite certain, that they can very easily be considerably corrected and multiplied, especially as regards what are at present called the *rarer* minerals. The table plainly shows the imperfection of the published analyses, and the many gaps that may and ought to be filled up forthwith.

There are said to be at present 66 elementary or simple bodies, and it is most interesting, as well as important, to observe their several degrees of intimacy, and to speculate upon what other relations they may bear to each other. The mineral species, arranged under their respective bases, numerically stand somewhat as follows:—Aluminium, 195; iron, 125; calcium, 94; carbon, 70; copper, 65; lead, 64; magnesium, 58; silver, 40; nickel, 28; manganese, 28; zinc, 25; sodium, 20; bismuth, 18; cobalt, 17; uranium and antimony, 16 each; cerium and zirconium, 12 each; yttrium, 10; potassium and gold, 9 each; mercury, 8; arsenic, 7; barium, 6; palladium, silicium, and titanium, 5 each; hydrogen and nitrogen, 4 each; chromium, oxygen, sulphur, tellurium, and tin, 3 each; cadmium, irridium, ammonium, molybdenum, selenium, strontian, and thalium, 2 each; beryllium, boron, cæsium, chlorine, platinum, ruthenium, thorium, and tungsten, 1 each; bromine, columbium, didymium, erbium, terbium, fluorine, indium, iodine, osmium, lithium, phosphorus, rhodium, rubidium, tantalum, and vanadium, *nil*. Of this large number of mineral species, those which we are accustomed to call the *useful* metals number only about 86: of these iron claims 15; copper, 14; silver, 10; mercury, 6; gold, lead, and antimony, 5 each; zinc, cobalt, and manganese, 4 each; arsenic, 3; iridium, nickel, and tin, 2 each; platinum, palladium, chromium, titanium, and bismuth, 1 each; and it is rather remarkable that the minerals used and admired for the purposes of *ornamentation* are numerically about the same as those called the *useful* metals.

In the table referred to it is shown that of the 66 elementary substances their obvious relations, according to the published analyses, are numerically as follows:—Oxygen and iron, 50 each; calcium, 46; aluminum, 43; manganese, 42; silicium, hydrogen, copper, and lead, 39 each; sulphur and magnesium, 37 each; carbon, 33; uranium, 31; yttrium, 29; cerrium, 28; zinc and sodium, 27 each; zirconium, potasstum, and silver, 24 each; nickel, 22; cobalt, phosphorus, and antimony, 21 each; bismuth and beryllium, 19 each; mercury and arsenic, 18 each; barium, chlorine, and thorium, 17 each; gold, chromium, lantharium, and tin, 16 each; fluorine, 15; molybdenum and nitrogen, 14 each; titanium and vanadium, 13 each; boron and iodine, 12 each; platinum, selenium, and tellurium, 11 each; iridium, strontian, tantalum, and tungsten, 9 each; lithium and columbium, or niobium, 8 each; cæsium and palladium, 7 each; cadmium, 6; bromine, didymium, and thallium, 5 each; indium and rhodium, 4 each; erbium, osmium, rubidium, and terbium, 3 each; ruthenium, 2.

In the table the chemical symbols are arranged alphabetically, for easy reference; but it can be better utilised if the elements are taken for consideration in something like the following order:—

1.—Those conveniently called the four generators of organisation (organogens)—the acid-former, and life-supporter, oxygen; the air-former, nitrogen; the water-former, hydrogen; and the fuel-former, carbon.
2.—The four fire-formers (pyrogens)—selenium, phosphorus, sulphur, and tellurium.
3.—The two glass-formers (hyalogens)—silicium and boron.
4.—The four salt-formers (halogens)—chlorine, fluorine, bromine, and iodine.
5.—The six metals of the basic salts—potassium, sodium, lithium; rubidium and cæsium, rare; and the hypothetical ammonium. [barium.
6.—The four alkaline earthy metals—calcium, magnesium, strontian, and
7.—The ten earthy metals—aluminium; beryllium, zirconium, yttrium, thorium, cerium, lanthanum, erbium, didymium, and terbium—rare.
8.—The eight noble metals, whose oxides are reducible by heat alone—gold, silver, mercury; platinum, iridium, osmium, rhodium, and ruthenium—rare.
9.—The eleven heavy metals, whose oxides form powerful bases—lead, copper, iron, zinc, manganese, nickel, chromium, cobalt, cadmium, uranium, and palladium.
10.—The twelve lighter metals, whose oxides form weak bases or acids—tin, bismuth, antimony, arsenic; vanadium, tungsten, tantalum, titanium, molybdenum, columbium, thallium, and indium—rare.

These statistics are the result of a careful analysis of our *paper books*, which, as I have said, are by no means to be relied on. I feel, however, very positive that if the *stone books* of nature be more deliberately opened this table will undergo much revision, and a greater number of relationships will be set up. I have, therefore, placed before the Section these notes suggestively, for the prompt application of spectrum analysis in the determination, qualitatively, of the composition and relations of many inorganic substances that now hold a very ambiguous position in mineralogical science.

Geologists, as a rule, are apt to undervalue mineralogical relationships. This, to me, appears a mistake, for, as with specimens of humanity so often with minerals, it may be said—"Tell me what company you keep, and I will tell you who you are."

ON IMPROVED APPLIANCES FOR THE PRODUCTION OF HEAVY FORGINGS.

By Lieut.-Colonel CLAY, of the Birkenhead Forge.

The forging of iron in large masses is a subject of so much importance to our engineering industry that it needs little apology for its introduction to the Mechanical Section of the British Association, and any improvement in the machinery or appliances for the more economical or rapid manufacture of large masses of wrought-iron, or for any improvement in quality, must be of great interest to all manufacturers where such products are needed. These improvements in the manufacture of large forgings I intend to class under three heads. I propose simply to mention a few prominent facts very briefly, but shall be glad to answer any enquiries that members may require further information about.—1. Improved heating by Siemens' regenerative gas furnace.—2. Facilities for handling and moving large masses of wrought-iron from the furnace to the hammer, and for moving them under the hammer.—3. Improved hammers, with a clean, unfettered fall, and with such width of standards as to give the workman all the comfort and convenience possible in executing the necessary operations of shaping, forging, and cutting the material to the required form.

1st.—Improved heating by Siemens' regenerative gas-furnace. It is generally admitted that iron in large masses is greatly deteriorated by long exposure to high temperatures, and that a crystalline structure is developed in consequence of such a form and nature as to detract in a very great degree from the strength of the material. It must, therefore, be admitted that furnaces such as those of Siemens', which produce the most intense heat in the shortest possible time, must cause less deterioration to the product in hand than those which are slower in operation; but a more important item in this consideration is that by the facilities given for regulating the admission of gas and air in a neutral flame can be produced, and, in consequence, the iron may be preserved from that burning and oxidation which is the cause of the formation of those large facets or crystals which weaken many wrought-iron structures of large size to such an immense extent. Another improvement from these furnaces where the iron is prepared from the pig is that the gas-furnaces do not bring over the large amounts of unconsumed ash or *debris* from the coal which is usually deposited on the body of the iron made in the ordinary puddling-furnace, and, in consequence, the iron is more free from those specks and flaws which are so observable in ordinary iron, and which produce the heating and galling so common in large forgings, as heretofore made, and which cause the chief torment of the practical marine engineer. Perhaps the greatest advantage which the Siemens' furnace offers is in the manufacture of forgings of puddled steel, from the facility in which the flame of the furnace may be regulated—first, in the puddling process, and, secondly, in the heating of the puddled steel masses. In furnaces of ordinary construction a constant deterioration of the puddled steel must necessarily take place from the free oxygen present in the furnace; but in the Siemens' furnace the gases may be so regulated that a neutral flame is produced, and, consequently, the steel mass is heated without deterioration. I will not now enter into the question of economy of fuel, as this has been often discussed at meetings of mechanical engineers; nor will it be necessary to enlarge upon the great advantage, especially in large towns, of the absence of smoke, which has been hitherto thought a necessary nuisance in all branches of the iron manufacture.

The second improvement which I would wish to mention is improved facilities for handling and moving these large masses of iron when heated as above described, which is effected by hydraulic cranes and machinery of sufficient power to move these large masses almost instantaneously either from the furnace to the hammer or *vice versâ*, to raise and lower the load, or to increase or decrease the distance of the load from the centre of the crane.

The truth of the old adage, of striking when the iron is hot, will prevent any necessity of dwelling upon the advantage of rapidity of movement in dealing with large heated masses of iron. After the pieces of iron have been heated in the manner described, and when the machinery shown has brought the forging to the hammer, it is necessary that that instrument should be of the most approved description to cope with the material under operation in the best and quickest manner, and with the greatest possible comfort to the workman employed at the work designated. Hammers that are described as suspended are employed: they are carried upon wrought-iron girders, of 20 ft. span, which gives the hammerman such room for his operation and such freedom from any obstacle to his work as has seldom, if ever, been accorded before, and so much room to the rear is reserved that shafts 50 ft. or 60 ft. long could readily be made without any inconvenience.

THE COAL FIELDS OF ENGLAND.

A paper, of which the following is an abstract, was read before the British Association, by Prof. HULL, M.A., F.R.S., Director of the Geological Survey of Ireland, the subject of his remarks being the extension of the coal fields beneath the newer formations in England. The paper was accompanied by maps and a diagramatic section from the north-west to the south-east of England, intended to represent the arrangement of the strata along this line of country.

MAP No. 1; was intended to show the original distribution of the coal measures at the close of the Carboniferous period.
MAP No. 2; was intended to show the changes effected in these coal measure areas after the distributions and denudations which immediately preceded the deposition of the Permian rocks.
MAP No. 3; was intended to show the changes effected over the same areas after the disturbances and denudations which preceded the deposition of the Triassic formation. This map would, therefore, represent what, in the author's opinion, is the extent of the coal fields under the newer formation of England.
MAP No. 4; the general geological map of England and Wales, showing the distribution of these newer formations, completed the series.

Prof. Hull commenced by referring to the paper which Sir R. I. Murchison had laid before the Association at Nottingham, entitled "On the Parts of England and Wales in which Coal may, or may not, be looked for," and expressed his gratification that his own views, arrived at by a somewhat different process of reasoning, coincided in the main with those of his respected chief; especially as regarded the absence of coal in the Eastern and portions of the Midland Counties now overspread by the Mesozoic formations. He then proceeded to show that there was evidence for believing that the Coal measures were originally deposited in two continuous sheets, one to the north and the other to the south of a ridge of old land,

formed of Silurian rocks, which stretched eastward from Shropshire, along the south of the Dudley coal field. This ridge, or barrier, had probably never been altogether submerged beneath the waters in which the coal measures were deposited. Towards the north the boundaries of the coal formation were formed by the Cambro-Silurian rocks of North Wales, the Lake District, and portions of the Southern Uplands of Scotland. The southern limits were formed by the barrier of old land already described; and over this intervening area the coal measures were spread in one continuous sheet, and attained their greatest vertical dimensions towards the north-west. To the south of the barrier the strata were deposited in greatest thickness towards the west or south-west. At the close of the coal period disturbances of the strata, resulting probably from lateral pressure acting from the north and south, took place over the whole Carboniferous area of the North of England, whereby the strata were thrown into a series of folds, the axes of which ranged along approximately east and west lines. These disturbances were accompanied and followed by enormous denudations, by which the coal measures were swept away over large tracts of the North of England, and the northern limits of the Lancashire and Yorkshire coal fields were approximately determined. Referring to the tract south of the central barrier, it was shown that the east and west flexures being parallel to those of the North of England, were referable to the same geological period—the post-Carboniferous (or pre-Permian). At this period the northern and southern limits of the South Wales coal field, the axis of the Mendip Hills, and the easterly trend of the culm measures of Devonshire were approximately marked out. Denudation of strata on an enormous scale accompanied these movements. After the deposition of the Permian beds over the inclined and denuded edges of the Carboniferous rocks, disturbances, accompanied by extensive denudation, took place along lines nearly at right angles to those of the preceding period—along the north and south lines (approximately). To this epoch the axis of the Pennine chain, and all north and south trendings of the strata, were to be referred. Some of the results brought about by these movements were the disseverance of the Lancashire and Cheshire from the Yorkshire and Derbyshire coal fields; the determination of the western limits of the Flintshire and Denbigshire coal fields; the disseverance of the Forest of Dean coal field from that of South Wales; and the uptilting of the lower Carboniferous rocks along the eastern margin of the Somersetshire coal field beneath the Jurasic formations. From these considerations it seemed clear that the basin-shaped form of nearly all the coal fields (the basins being sometimes partially concealed by Mesozoic rocks) was due to denudation acting over areas of elevation intersecting each other nearly at right angles, and corresponding to two distinct epochs—the pre-Permian and pre-Triassic. The author then proceeded to show that over these Carboniferous basins the Permian and Triassic rocks were distributed according to a well-defined plan of "south-easterly attenuation," thinning away towards the south-east; and concluded by discussing the views of Sir R. I. Murchison, Prof. Ramsay, and Mr. Godwin-Austin, regarding the existence or absence of coal under the Cretacious or Tertiary strata of the South of England.

The President said the paper was of the highest geological importance, especially at the present time, when we had so much excitement with regard to the probable extent of our coal fields, and at a time when the question was engaging the attention of a Royal Commission.

Prof. Phillips confessed to very great interest in investigations which referred to the extent of our actual possessions and future prospects in regard to coal supplies; but he entertained the doubt whether, after all, their prospects of obtaining coal from the extent already known had not been taken at the minimum.

Mr. Warington W. Smyth thought it highly important that the paper should go forth to the world as pointing out that there was very great reason for believing that we could not indulge in wild views of uninterrupted fields of coal to be wrought far to the eastward of our existing coal fields, and to the borders of the German Ocean. Whilst they ought to receive with admiration Prof. Hull's paper as regarded what portion of the original enormous coal fields were left them; they might also consider its value very great, because it enabled them to see the great probability of certain lines beyond which they should not allow their imaginations to stray, or expect valuable coal fields to extend.

A NEW COLLIERY LAMP.

The importance of any means which can be devised having for their object the saving of human life, by rendering the occupation of the coal miner less hazardous, and the interest which the British Association has always felt in any invention conducive thereto, must be my apology for the introduction of a short paper on a Colliery Lamp, on an entirely new principle, recently patented by Messrs. W. E. Teale and Co., Mark lane, Manchester. The attention of mine owners and practical men, both in this and other countries, has been long occupied by attempts to construct a lamp which shall satisfy the requirements of the mine, by combining with safety a powerful light and simplicity of mechanism, and the realisation of this want must be of deep interest to all those who are responsible for the safety and welfare of their men, those who have such enormous properties at stake, and to every well-wisher to the brave men who risk their lives in the dark and dangerous mine, on whom we depend for the comfort of the winter hearth, and without whose labours our factories and workshops would be brought to a standstill, and the most noble navies of the world would ride idly in harbour. To Sir Humphry Davy we are indebted for the invention of the lamp that bears his honoured name, by means of which thousands of lives have been saved, and in the many modifications and improvements which have since been made the fine wire-gauze has been necessarily retained, as in the Stephenson, or "Geordie," where it forms the entire length of the top, with a glass inside, or partly glass and gauze, as in the Clanny lamp, in which the glass forms a light chamber below the gauze, both of which in many respects show a great improvement on the original Davy lamp—the one much more trustworthy in fiery mines, while the other gives a far better light. It is admitted that flame may, under certain circumstances, pass the naked gauze, and men are known constantly to light their pipes by drawing the flame through it, which is rendered impossible when glass is also used. Many other patents have been taken out, too numerous to specify, for various improvements in colliery lamps, with the object either of improving the light, of rendering the lock which is generally used in them more secure, or of extinguishing the flame in case the lock should be tampered with; but in all cases, so far as my observation has gone, the old principle of feeding the lamps with oil of various descriptions has been adhered to, consequently smoke and soot are largely produced, clogging the gauze, or glass and gauze, destroying the efficiency of the light, and thereby rendering the temptation to the collier to remove the top of the lamp, that he may obtain sufficient light to enable him to work, almost a necessity; so that we seem, so far as our coal mines are concerned, to be indulging still in the glorious brilliancy in which, before the introduction of gas, our grandfathers rejoiced in their city streets in the early part of this our nineteenth century.

Mr. Baker, the Government Inspector of Mines, who in addressing, as their President, the Midland Institute of Mining Engineers, early last month, at Wolverhampton, remarks that "the term safety-lamp was a misnomer; no lamp yet invented was perfectly safe." So far I am bound to concur, in respect to the oil-burning lamp, from the fact that many deplorable accidents have been distinctly traced to either the inherent defects of our present lamps, or to the fact of the collier having tampered with the top to improve his light; and, doubtless many fearful explosions have occurred in which hundreds of lives have been sacrificed, wherein death, fire, and destruction have effectually removed all trace of these fertile sources of danger. And I may mention, in passing, the following facts,—that when oil is carelessly spilt, and left on the outside of the gauze, or when by overturning the lamp it may run out of the reservoir inside, coal dust will naturally adhere to the exterior of the oily gauze, and, on the same being over heated by burning gas in the lamp, a sufficient flicker may be produced to fire the mine; the hole through which the pricker works may, likewise, become so enlarged as to allow the passage of flame, with a like result.

To prevent the miner tampering with his lamp to light his pipe, or by removing the top to increase the brilliancy of the light, so as to facilitate his work, a number of patents have been taken out, with the object of extinguishing the flame on his attempting to do so, involving in most cases the use of springs, by the action of which an extinguisher is brought to bear on the flame; but a spring is evidently likely to be weakened by use, or to break by becoming rusty in a damp mine, and, therefore, a poor reliance is to be placed on its certain action at the critical moment when life and property are at stake. Much, undoubtedly, depends upon the attention paid to the thorough ventilation of mines; indeed, some practical men are of opinion that where it is properly looked to naked lights may be safely used; but in several fearful accidents which have occurred of late in pits where good ventilation was a primary care on the part of the managers, a momentary cessation, entirely unforseen, in connection with insecure lights, has scattered death and destruction to all within reach. Gunpowder, another fertile source of explosions, would be robbed of some of its danger if a really safe lamp only were used.

With a view to remedy so far as possible the dangers arising from the insecurity of the present oil lamps, the "Patent Protector Colliery Lamp," the subject of this paper, has been carefully and thoughtfully designed, to combine safety and brilliancy of light with cleanliness and economy. It is made on the principle of the ordinary sponge or portable gas lamp, in which is used a liquid specially prepared for it by the inventors. The reservoir, or gas-holder, is then screwed to the top of an ordinary Stephenson or Clanny lamp, within which is fixed a pair of horizontal hinges, moving upwards only. On the wick-tube of the lamp, and sliding over it, is an outer tube, having round its centre a circular horizontal flange; when the reservoir is screwed upwards into the top, this flange comes in contact with the hinges, raises them in passing, and allows them to fall beneath it when screwed home, so that by reversing the screw, and withdrawing the reservoir gradually from the top, the said hinges prevent the return of the said sliding tube, thereby forcing it over the wick-tube, and so diminishing, and ultimately extinguishing, the light. It is, therefore, impossible for a naked light to become exposed after the lamp has once been adjusted. To render security doubly sure, a lock and stop are so placed that after the light is put out by the action of the screw it is still impossible for the collier to withdraw the reservoir from the top, so as to re-light his lamp. The safety of the mine is further ensured by the fact that the gauze is kept perfectly clean, and, therefore, no coal dust can adhere to it, as in the old oil lamps. In regulating and reducing the light when testing for gas, which can be done with the greatest ease and certainty, no pricker is used or required, and another source of danger is avoided. This lamp burns freely with less ventilation than any now in use, and is much more sensitive to the presence or action of gas, while it is impossible for the miner to light his pipe from or tamper with the light in any manner. It gives a much more brilliant light than that produced by the very finest oil, and as neither smoke or soot is made by combustion, the glass and gauze are as clean, and the light as good, at the end of the day as when the miner goes down the pit, and this without the trouble and great loss of time necessary to keep an oil lamp properly trimmed.

As compared with oil, the cost of burning the Patent Protector Colliery Lamp is very small, six days of ten hours each, or sixty hours, being obtained at a cost of 3d., or less than one half the price of ordinary miners' candles, and one-third that of the usual oil.

The lamp has been seen and highly approved of by several Government Inspectors and many practical men, and tested repeatedly in the pits, where it has given entire satisfaction.

FOREIGN MINING AND METALLURGY.

The average number of blast-furnaces working in the Charleroi basin in 1869 was 25; in 1868, 22; in 1867, 24. The number of furnaces out of blast last year was 12, against 16 in 1868, and 15 in 1867. The number of workmen engaged was 2340 in 1869, as compared with 2300 in 1868, and 2224 in 1867. In 1869 the production amounted to 307,446 tons, while in 1868 it was 265,580 tons, and in 1867, 256,000 tons. The number of foundries in working in the Charleroi district last year was 39, as compared with 36 in 1868, and 41 in 1867. The number of steam-engines in the foundries last year was 39, of an aggregate force of 320 horse-power, as compared with 36 engines, of an aggregate force of 296 horse-power in 1868, and 39 engines, of an aggregate force of 308 horse-power in 1867. The number of workmen employed last year was 889, as compared with 826 in 1868, and 847 in 1867. The production was 16,538 tons last year, against 16,225 tons in 1868, and 17,466 tons in 1867. The number of rolling-mills in the basin last year was returned at 20, as compared with 21 in 1868, and 25 in 1867. The number of steam-engines at work last year was 190, of an aggregate force of 5939 horse-power, as compared with 169, of an aggregate force of 5477 horse-power in 1868, and 161, of an aggregate force of 5178 horse-power in 1867. There were also three water-wheels in operation last year, of an aggregate force of 115 horse-power, as compared with 42, of an aggregate of 582 horse-power in 1868 and 1867. The number of workmen employed last year was 7182, as compared with 5346 in 1868, and 5120 in 1867. The production last year amounted to 261,938 tons, against 180,746 tons in 1868, and 193,919 tons in 1867. The number of establishments for working iron stood last year at 20, as compared with 24 in 1868, and 19 in 1867. Their production amounted last year to 1904 tons, against 2322 tons in 1868, and 2371 tons in 1867.

We again find it impossible to attempt any report of the French iron trade, crippled and disorganised as it is by the existing unhappy war.

Metallurgy has made rapid strides of late in Austria and Hungary. In 1845 the production of those countries was only about 175,000 tons; in 1869 it was estimated at about 395,000 tons. In 1845 the production of rough iron in Germany was confined almost exclusively to Silesia and the Duchy of Nassau. The whole territory comprised in the Zollverein only produced 180,000 tons. In 1850 the first discovery was made of the blackband minerals of Westphalia, the rapid and energetic working of which has produced the best results. According to official data, the metallurgical production of the Zollverein was 1,032,000 tons in 1867, in 1868 it had further grown to 1,169,600 tons, and the total for 1869 is estimated on good authority at 1,220,000 tons. France has more than tripled her metallurgical production during the last 20 years. In 1845 statistics collected by the Administration of Mines showed a total production of iron of 438,969 tons; in 1869 the total production amounted, according to the estimates of the Committee of French Forgemasters, to 1,380,000 tons. Belgian metallurgy has made astonishing strides. In 1865 the iron production of Belgium was only 185,000 tons; in 1869 it amounted to 863,000 tons. The production of rough iron in Russia has not experienced any change; it is estimated at about 80,000 tons per annum; import duties have been largely reduced, and the Russian Government is now endeavouring to stimulate and develope Russian metallurgy. Spain makes little progress in metallurgy, but forwards her minerals in large quantities to Great Britain, France, and Belgium.

The state of the Belgian coal trade remains one of some difficulty. The various working companies find themselves under the necessity of restricting their production, and may, perhaps, soon be obliged to carry out a reduction of wages. This measure will only, however, be adopted as a last resource; its execution will be postponed as long as possible. If we may credit the information which comes to hand from the various coal-producing centres, the coalowners have come to an understanding to maintain the price of their products, notwithstanding the stocks which are accumulating. It remains to be seen whether this decision can be enforced, and if so, for how long. The deliveries of coal made by Belgium to Holland, without being very considerable, have, nevertheless, been satisfactory, but the French market is still closed to a great extent against Belgian coal-workers. There are also great complaints of railway delays on the various frontiers. The coke trade is a good deal tried by the idleness of almost all the blast-furnaces to which important deliveries were made.

It is stated that the Belgian Government has come to an understanding with some of the leading Belgian metallurgists with regard to the orders for rails to be given out for the State Railways. It is understood that forgemasters in the Hainaut and the province of Liége will share these orders. The Belgian Government has also under consideration the desirability of giving out an important order for locomotives. Negociations undertaken on the subject are stated to be nearly carried through, but no certain information has reached us as regards the state of affairs. Thus far the works have maintained a certain amount of activity, although orders have only come to hand of late to a small extent. Orders for merchants' iron are tolerably well sustained, and there is also a certain demand for plates, although transactions have rather fallen off. As the Franco-Prussian war seems likely to go on, it is to be feared that Belgian metallurgy will be exposed to continued trials. Under these circumstances increasing pressure is being brought to bear upon the Government, to induce the administration to engage in great works of public utility.

The continental metal markets continue to reflect the consequences of the grave crisis prevailing in European affairs. At Rotterdam, Drontheim copper was last quoted at 50 fls. to 52 fls. A good demand for tin has been noted at Berlin. In Holland disposeable Banca tin has made 75 fls. to 75¼ fls.; for deliveries to be made at the approaching sale of the Society of Commerce, the price paid has been 72 fls. to 72¼ fls. Billiton in schedules has made 74 fls. Lead has been rather firmer upon the German markets. At Rotterdam prices have experienced no change. The German zinc markets show a good deal of languor. Details with regard to the French metal markets can scarcely be given under the present painful circumstances.

FOREIGN MINES.

St. John del Rey.—The directors have received, per Sindh, the following report, dated Morro Velho, Aug. 29:—Morro Velho produce, second division of August, 13 days, 4172 oits.; yield, 2·384 oits. per ton. The above is the best gold return we have had for some time, owing to the increased supply of stone from the Gamba Mine.

Don Pedro North del Rey (Gold).—F. S. Symons, Aug. 29: Mine: A little box-work has been taken from line No. 6, ascending. Nothing has been done in the bottom of the mine, through water. The reserves have yielded average work, but not rich. Some promising samples have been taken from Alice's west; we have commenced to stope a section of the lode, and hope as it is opened on to encounter better ground than we have yet met at this section. The cross-cut south from Alice's west has been pushed on day and night with a view of intersecting the lode that was worked on in 1867 at Hilcke's west but abandoned on richer shoots being discovered. The ground in the middle adit has been very wet and troublesome, but at Treloar's level good. The cutting down brushwood at Mato des Cobras is being prosecuted with all speed the debris of old workings are being brought to light. The water-wheel to drive the pumping machinery will, we hope, go to work on the 31st. The horse-engine was turned idle on the 27th, and animals sent to the "Retoro;" a heavy cost has ceased.—Produce: Weighed to date, 6039 oitavas; estimate for the month, 7539 oitavas.

Taquaril (Gold).—Mr. T. S. Treloar, Aug. 28: The works connected with stamping mill, wash-house, spalling-floors, and tram-roads, are progressing with such good dispatch that I have pleasure in confirming the statement set forth in my last respecting their completion. In Old Mine all the changes thus far found necessary in timber work have been made; and the excavations in vicinity of shaft enlarged, so as to facilitate transit of debris from workings, and quarring when our appliances for treating the ore are in readiness. To effect the enlargement without breaking rich auriferous matter, the white sandstone between the two lodes has been removed, thus uncovering about 7 feet of the shoot descending in under lode. Some of this will be extracted and treated at the sampling-room in the presence of Capt. Treloar, who I expect on the 29th. Shoot and jacotinga in the top lode, and all other veins met with have also been uncovered for his inspection. The sandstone before mentioned has been placed with the crushed matter at surface, in deposit for stamps, some of the samples taken from it having produced gold. The new engine-shaft intercepted the top lode on the 23d at a depth of 21 fms. 2 feet from the shallow adit, and I am pleased to state that, with very few exceptions, the trials made of same to date have proved satisfactory, the stone showing fair work for stamps. The ground at this point before the lode was struck had become soft and extremely troublesome, and sinking proceeded slowly in consequence. At the deep adit good duty is being done.

Rossa Grande (Gold).—E. Hilcke, Aug. 28: Mine: The works have proceeded with regularity. At Mina da Serra the lode in the 70 fm. level east is increasing in size, but I am sorry to say it is extremely poor. In the 50 fm. level west, and in the stopes above and below the 40 fm. level, near the adit, the lode maintains its good quality, but is still very bunchy. In extending the level west, at the Cachoeria Mine, we find a little improvement in the quality of the lode. At Gongo nothing new occurred in the exploratory works.

General Brazilian (Gold).—Thos. Treloar, Aug. 27: General Operations: Everything, I am pleased to say, is proceeding satisfactorily. The old adit, at St. Anna, is advancing apace, and our men are handling the ground in the shallow adit in a masterly manner. The gratuity offered, coupled with the experience they have had in handling the flookan, is turning out so far very advantageous. The ground in the adits at Itabira is loose sandy jacotinga, but so far both adits are dry, and the progress all we could desire. The weather is very fine, and the surface works are advancing at a rattling pace.

Anglo-Brazilian (Gold.)—F. S. Symonds, Aug. 26: General Remarks: The sick list is favourable, and the attendance better than when last commented on. In the mine operations are proceeding in the usual regular manner, with little alteration to notice, excepting that at one part of Dawson's killas is encroaching. The deep adit section continues to be fully manned, and the lower cabeceiras, at Foster's, are being vigorously pushed on, so as to unwater the Fundao sections at a deeper horizon.

United Mexican.—Guanajuato, Aug. 20: Mine of Jesus Maria y Jose: In the bajo of the old working of La Trinidad a buscon has discovered a rich strip of ore, and our sales have somewhat increased on account of the ore extracted from that working. On advancing on it southwards the ore has increased in quantity, but has got poorer in quality; but as soon as we have more ground laid open we shall commence a pozo, as the silver seems to make downwards. In this last week a holiday on the 15th has sadly interrupted our work and the extraction, both from the hacienda and buscon workings, has fallen off. The sales have been on the 4th inst., $2162; on the 11th, $2130; and on the 18th $1542. The accounts for the month of July show a loss of $2497; against which must be placed the gold from the raspa appertaining to the month.—Mine of Remedios: The frentes from Remedios, going off northwards towards the mine of La Trinidad, are all poor; and in the highest level, San Crescencio, though the lode is in good ore, it is narrower than below. The sales have continued to be fair—on the 4th inst., $1900; on the 11th, $1700; and on the 18th, $135 The July accounts left for the company's share a small profit of $827.—New Concern—Adit of San Cayetano: The rock has got very hard this month, and the heat also is almost insupportable. We advanced in July only 6 varas.—Mine of Buenos Ayres: In the southern frente of Buenos Ayres, going to meet the adit, the rock is hard, but the workmen advanced last week 2 metres.—Mine of San Antonio de la Ovejera: The cross-cut from the San Antonio shaft was stopped at the end of July, and since then we are deepening the shaft itself to have a reservoir for the water which we expect to meet on cutting the lode. The rock both in the shaft and cross-cut, is uncommonly hard, and in the former we have only advanced in two weeks 2·74 metres. As I intend it only to be about 5 metres deep, I trust that on Aug. 25 we may continue the cross-cut.

Pestarena.—T. Roberts, J. Mitchell, Sept. 21: We consigned today to Carlo Menozzi, on account of the present month, 6 ingots of gold, four weighing 7225 grammes, equal to 232 ozs. 8 dwts. 9 grs., was obtained from 3 tons of ore from Val Toppa Mine. One ingot, weighing 3645 grammes, equal to 117 ozs. 5 dwts. 3 grs., is the produce from 103 tons of ore amalgamated at Pestarena Mines by the small mills; and one ingot of the weight of 1755 grammes equal to 56 ozs. 9 dwts., was produced at Battigio establishment from 103 tons of ore from Pestarena. The total weight of the above ingots is 12,625 grammes equal to 406 ozs. 2 dwts. 12 grs., produced from 569 tons of ore.

Eclipse (Gold).—Report for August from Capt. Barratt: We have opened on the lode in the outcrop south of the cross-course. The end is now about 3 fathoms 3 feet; the lode is 8 feet wide, of a very promising nature, composed of the same kind of quartz as that in the north mine, only being near the surface of it, is not so auriferous. At intervals it shows good samples, but not sufficient gold to be treated in the mill. I anticipate this champion lode will in a few feet more driving come into good pay ore. The main shaft I have suspended for the present, as well as the north bottom end, and the men are cutting down main shaft to put in double track for the more speedy discharge of the quartz ore. A whim will also be prepared and fixed on main shaft. The system of taking the ore out of the mine by mule, by single track as formerly, is too slow for our present requirements. This track I hope will be finished in a month, when the sinking of main shaft, driving tunnels and stoping ore, will be resumed and carried on without intermission. The engineer with staff is busily engaged fixing the cylinder bed and other preliminary work against the engine and stamps arrive. The boiler and some of its fittings will be here in a week and boiler-makers from San Francisco will soon be here to put it together. Probably the engine and other machinery from England have ere this arrived at San Francisco; that will also be dispatched here without delay, and on their arrival will immediately be erected. All the different points of operation are being pushed on with all possible dispatch and with due regard to economy.

Cape Copper.—Captain Williams, Aug. 5: Ookiep: The engine shaft during the past month has been sunk 2 ft. 6 in., in very hard and trouble some ground, but we are in hopes that we are very near a change for the better as the rock is full of cross-heads throughout the shaft, which makes it so very spare and troublesome for sinking; re-set, August 1, to three men and six labourers, at 69l. per fathom, for 1 fathom, or the month. The 40, south of the flookan course, has been extended 1 fm. 3 ft. during the past month, through unproductive ground; at present it is very hard and poor; re-set, August 1, to two men and two labourers, at 19l. per fathom, for two fathoms, or the month. The two stopes in the back of the 40 are not looking quite so well; each stope will now yield about 6 tons of copper ore per fathom; re-set, Aug. 1, to five men and ten labourers, at an average price of 3l. 10s. per fathom, for 30 fms., or the month. We have resumed the driving of the 40, south-west from No. 5 winze by two men and two labourers, at 12l. per fm., for 2 fms., or the month; this end will yield from 7 to 8 tons of good copper ore per fm. The 30 east, on Job's branch, has been extended during the past month 1 fm. 2 ft. 6 in., in ground that has produced a little copper ore, and is looking very promising to improve; re-set, Aug. 1, to one man and one labourer, at 12l. per fathom, for 2 fathoms, or the month. The winze below the 20, on Job's branch, has been sunk during the past month 5 ft. 1 in. in productive ground, at present looking very kindly, and producing good stones of copper ore; re-set to one man and three labourers, at 17l. per fathoms, for 2 fathoms, or the month. The 24 west has during the past month been extended 1 fm. 1 ft. 9 in., the first 6 ft. in good ore ground, and the last 1 ft. 9 in. unproductive; we are now driving this level north on a good course of copper ore, that will yield about 8 tons per fathom; re-set, Aug. 1, to one man and one labourer, at 14l. per fathom, for 2 fathoms, or the month. The winze below the 20 has been sunk during the past month 4 ft. in unproductive ground; re-set, Aug. 1, to two men and two labourers, at 20l. per fathom to hole. Our sampling for the past month, I am sorry to say, is short of our usual quantity, in consequence of several of our labourers refusing to work, for which they got one month's imprisonment; also cleaning one of the boilers hindered the whim-engine for nearly a week, and the pump being out of order on the wash-floors. These misfortunes taking place at the same time caused the great falling off in our sampling, but I think we shall be able to make up the full quantity by the end of the year. Further rains had fallen, and the riding season is unusually favourable.—Returns: Ookiep, 287 tons; Spectakel, 109 tons total transport to coast, 793 tons. The construction of tramway was completed to 33 miles: 256 tons of ore were sold on the 20th inst. by public ticket, at 12s. 8¾d. per unit.

New Zealand (Quartz Crushing and Gold).—J. Thomas, Auckland, Aug. 6: The erections and works are proceeding most satisfactorily, Mr. Taylor, the contractor, doing every justice to his work in making the plant one of the strongest and most complete batteries in New Zealand. He will duly fulfil his contract within his specified time of three months, consequently I hope we shall be in a position to get up steam for a final start in about four or five weeks' time from this date.

[For remainder of Foreign Mines see to-day's Journal.]

The Calabria and Java have brought a further shipment of $17,000 in silver bars from the South Aurora Silver Mine, White Pine.

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